

## High-Speed CMOS Logic 4-Bit Parallel Access Register

### Features

- Asynchronous Master Reset
- J,  $\bar{K}$ , (D) Inputs to First Stage
- Fully Synchronous Serial or Parallel Data Transfer
- Shift Right and Parallel Load Capability
- Complementary Output From Last Stage
- Buffered Inputs
- Typical  $f_{MAX} = 50\text{MHz}$  at  $V_{CC} = 5\text{V}$ ,  
 $C_L = 15\text{pF}$ ,  $T_A = 25^\circ\text{C}$
- Fanout (Over Temperature Range)
  - Standard Outputs . . . . . 10 LSTTL Loads
  - Bus Driver Outputs . . . . . 15 LSTTL Loads
- Wide Operating Temperature Range . . .  $-55^\circ\text{C}$  to  $125^\circ\text{C}$
- Balanced Propagation Delay and Transition Times
- Significant Power Reduction Compared to LSTTL Logic ICs
- HC Types
  - 2V to 6V Operation
  - High Noise Immunity:  $N_{IL} = 30\%$ ,  $N_{IH} = 30\%$  of  $V_{CC}$  at  $V_{CC} = 5\text{V}$

### Description

The device is useful in a wide variety of shifting, counting and storage applications. It performs serial, parallel, serial to parallel, or parallel to serial data transfers at very high speeds.

The two modes of operation, shift right ( $Q_0$ - $Q_1$ ) and parallel load, are controlled by the state of the Parallel Enable ( $\bar{PE}$ ) input. Serial data enters the first flip-flop ( $Q_0$ ) via the J and  $\bar{K}$  inputs when the  $\bar{PE}$  input is high, and is shifted one bit in the direction  $Q_0$ - $Q_1$ - $Q_2$ - $Q_3$  following each Low to High clock transition. The J and K inputs provide the flexibility of the JK-type input for special applications and by tying the two pins together, the simple D-type input for general applications. The device appears as four common-clocked D flip-flops when the  $\bar{PE}$  input is Low. After the Low to High clock transition, data on the parallel inputs (D0-D3) is transferred to the respective  $Q_0$ - $Q_3$  outputs. Shift left operation ( $Q_3$ - $Q_2$ ) can be achieved by tying the  $Q_n$  outputs to the  $D_{n-1}$  inputs and holding the  $\bar{PE}$  input low.

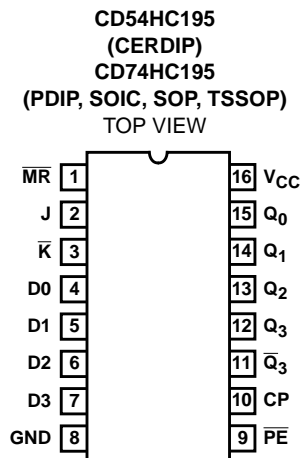
All parallel and serial data transfers are synchronous, occurring after each Low to High clock transition. The 'HC195 series utilizes edge triggering; therefore, there is no restriction on the activity of the J, K, Pn and  $\bar{PE}$  inputs for logic operations, other than set-up and hold time requirements. A Low on the asynchronous Master Reset ( $\bar{MR}$ ) input sets all Q outputs Low, independent of any other input condition.

### Ordering Information

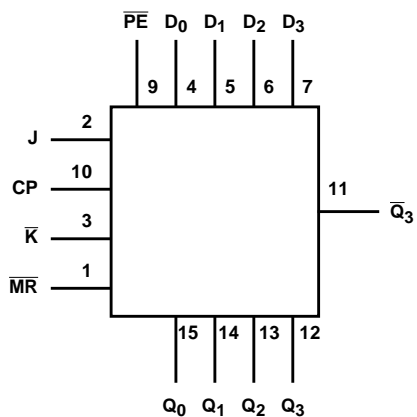
PART NUMBER	TEMP. RANGE (°C)	PACKAGE
CD54HC195F3A	-55 to 125	16 Ld CERDIP
CD74HC195E	-55 to 125	16 Ld PDIP
CD74HC195M	-55 to 125	16 Ld SOIC
CD74HC195NSR	-55 to 125	16 Ld SOP
CD74HC195PW	-55 to 125	16 Ld TSSOP
CD74HC195PWR	-55 to 125	16 Ld TSSOP
CD74HC195PWT	-55 to 125	16 Ld TSSOP

NOTE: When ordering, use the entire part number. The suffix R denotes tape and reel. The suffix T denotes a small-quantity reel of 250.

### Pinout



**Functional Diagram**



TRUTH TABLE

OPERATING MODES	INPUTS						OUTPUT				
	$\overline{MR}$	CP	$\overline{PE}$	J	$\overline{K}$	D <sub>n</sub>	Q <sub>0</sub>	Q <sub>1</sub>	Q <sub>2</sub>	Q <sub>3</sub>	$\overline{Q_3}$
Asynchronous Reset	L	X	X	X	X	X	L	L	L	L	H
Shift, Set First Stage	H	↑	h	h	h	X	H	q <sub>0</sub>	q <sub>1</sub>	q <sub>2</sub>	$\overline{q_2}$
Shift, Reset First Stage	H	↑	h	l	l	X	L	q <sub>0</sub>	q <sub>1</sub>	q <sub>2</sub>	$\overline{q_2}$
Shift, Toggle First Stage	H	↑	h	h	l	X	$\overline{q_0}$	q <sub>0</sub>	q <sub>1</sub>	q <sub>2</sub>	$\overline{q_2}$
Shift, Retain First Stage	H	↑	h	l	h	X	q <sub>0</sub>	q <sub>0</sub>	q <sub>1</sub>	q <sub>2</sub>	$\overline{q_2}$
Parallel Load	H	↑	l	X	X	dn	d <sub>0</sub>	d <sub>1</sub>	d <sub>2</sub>	d <sub>3</sub>	$\overline{d_2}$

H = High Voltage Level

L = Low Voltage Level,

X = Don't Care

↑ = Transition from Low to High Level

l = Low Voltage Level One Set-up Time Prior to the Low to High Clock Transition

h = Low Voltage Level One Set-up Time prior to the High to Low Clock Transition,

dn (q<sub>n</sub>) = Lower Case Letters Indicate the State of the Referenced Input (or output) One Set-up Time Prior to the Low to High Clock Transition.

# CD54HC195, CD74HC195

## Absolute Maximum Ratings

DC Supply Voltage,  $V_{CC}$  ..... -0.5V to 7V  
 DC Input Diode Current,  $I_{IK}$   
 For  $V_I < -0.5V$  or  $V_I > V_{CC} + 0.5V$  .....  $\pm 20mA$   
 DC Output Diode Current,  $I_{OK}$   
 For  $V_O < -0.5V$  or  $V_O > V_{CC} + 0.5V$  .....  $\pm 20mA$   
 DC Output Source or Sink Current per Output Pin,  $I_O$   
 For  $V_O > -0.5V$  or  $V_O < V_{CC} + 0.5V$  .....  $\pm 25mA$   
 DC  $V_{CC}$  or Ground Current,  $I_{CC}$  or  $I_{GND}$  .....  $\pm 50mA$

## Thermal Information

Package Thermal Impedance,  $\theta_{JA}$  (see Note 1):  
 E (PDIP) Package .....  $67^{\circ}C/W$   
 M (SOIC) Package .....  $73^{\circ}C/W$   
 NS (SOP) Package .....  $64^{\circ}C/W$   
 PW (TSSOP) Package .....  $108^{\circ}C/W$   
 Maximum Junction Temperature .....  $150^{\circ}C$   
 Maximum Storage Temperature Range .....  $-65^{\circ}C$  to  $150^{\circ}C$   
 Maximum Lead Temperature (Soldering 10s) .....  $300^{\circ}C$   
 (SOIC - Lead Tips Only)

## Operating Conditions

Temperature Range ( $T_A$ ) .....  $-55^{\circ}C$  to  $125^{\circ}C$   
 Supply Voltage Range,  $V_{CC}$   
 HC Types ..... 2V to 6V  
 HCT Types ..... 4.5V to 5.5V  
 DC Input or Output Voltage,  $V_I, V_O$  ..... 0V to  $V_{CC}$   
 Input Rise and Fall Time  
 2V ..... 1000ns (Max)  
 4.5V ..... 500ns (Max)  
 6V ..... 400ns (Max)

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

### NOTE:

- The package thermal impedance is calculated in accordance with JESD 51-7.

## DC Electrical Specifications

PARAMETER	SYMBOL	TEST CONDITIONS		$V_{CC}$ (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS	
		$V_I$ (V)	$I_O$ (mA)		MIN	TYP	MAX	MIN	MAX	MIN	MAX		
High Level Input Voltage	$V_{IH}$	-	-	2	1.5	-	-	1.5	-	1.5	-	V	
				4.5	3.15	-	-	3.15	-	3.15	-	V	
				6	4.2	-	-	4.2	-	4.2	-	V	
Low Level Input Voltage	$V_{IL}$	-	-	2	-	-	0.5	-	0.5	-	0.5	V	
				4.5	-	-	1.35	-	1.35	-	1.35	V	
				6	-	-	1.8	-	1.8	-	1.8	V	
High Level Output Voltage CMOS Loads	$V_{OH}$	$V_{IH}$ or $V_{IL}$	-0.02	2	1.9	-	-	1.9	-	1.9	-	V	
				4.5	4.4	-	-	4.4	-	4.4	-	V	
				6	5.9	-	-	5.9	-	5.9	-	V	
High Level Output Voltage TTL Loads	$V_{OH}$	$V_{IH}$ or $V_{IL}$	-	-	-	-	-	-	-	-	-	V	
				-4	4.5	3.98	-	-	3.84	-	3.7	-	V
				-5.2	6	5.48	-	-	5.34	-	5.2	-	V
Low Level Output Voltage CMOS Loads	$V_{OL}$	$V_{IH}$ or $V_{IL}$	0.02	2	-	-	0.1	-	0.1	-	0.1	V	
				4.5	-	-	0.1	-	0.1	-	0.1	V	
				6	-	-	0.1	-	0.1	-	0.1	V	
Low Level Output Voltage TTL Loads	$V_{OL}$	$V_{IH}$ or $V_{IL}$	-	-	-	-	-	-	-	-	-	V	
				4	4.5	-	-	0.26	-	0.33	-	0.4	V
				5.2	6	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	$I_I$	$V_{CC}$ or GND	-	6	-	-	$\pm 0.1$	-	$\pm 1$	-	$\pm 1$	$\mu A$	
Quiescent Device Current	$I_{CC}$	$V_{CC}$ or GND	0	6	-	-	8	-	80	-	160	$\mu A$	

## CD54HC195, CD74HC195

### Prerequisite For Switching Function

PARAMETER	SYMBOL	TEST CONDITIONS	V <sub>CC</sub> (V)	25°C		-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	MAX	MIN	MAX	MIN	MAX	
Clock Frequency	f <sub>MAX</sub>	-	2	6	-	5	-	4	-	MHz
			4.5	30	-	25	-	20	-	MHz
			6	35	-	29	-	23	-	MHz
MR Pulse Width	t <sub>w</sub>	-	2	80	-	100	-	120	-	ns
			4.5	16	-	20	-	24	-	ns
			6	14	-	17	-	20	-	ns
Clock Pulse Width	t <sub>w</sub>	-	2	80	-	100	-	120	-	ns
			4.5	16	-	20	-	24	-	ns
			6	14	-	17	-	20	-	ns
Set-up Time J, $\bar{K}$ , $\bar{PE}$ to Clock	t <sub>SU</sub>	-	2	100	-	125	-	150	-	ns
			4.5	20	-	25	-	30	-	ns
			6	17	-	21	-	26	-	ns
Hold Time J, K, $\bar{PE}$ to Clock	t <sub>H</sub>	-	2	3	-	3	-	3	-	ns
			4.5	3	-	3	-	3	-	ns
			6	5	-	3	-	3	-	ns
Removal Time, MR to Clock	t <sub>REM</sub>	-	2	80	-	100	-	120	-	ns
			4.5	16	-	20	-	24	-	ns
			6	14	-	17	-	20	-	ns

### Switching Specifications Input t<sub>r</sub>, t<sub>f</sub> = 6ns

PARAMETER	SYMBOL	TEST CONDITIONS	V <sub>CC</sub> (V)	25°C		-40°C TO 85°C	-55°C TO 125°C	UNITS
				TYP	MAX	MAX	MAX	
<b>HC TYPES</b>								
Propagation Delay, CP to Output	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 50pF	2	-	175	220	265	ns
			4.5	-	35	44	53	ns
			6	-	30	37	45	ns
Propagation Delay, MR to Output	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 50pF	2	-	150	190	225	ns
			4.5	-	30	38	45	ns
			6	-	26	33	38	ns
Output Transition Times (Figure 1)	t <sub>TLH</sub> , t <sub>THL</sub>	C <sub>L</sub> = 50pF	2	-	75	95	110	ns
			4.5	-	15	19	22	ns
			6	-	13	16	19	ns
Input Capacitance	C <sub>IN</sub>	-	-	-	10	10	10	pF
CP to Q <sub>n</sub> Propagation Delay	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 15pF	5	14	-	-	-	ns
MR to Q <sub>n</sub>	t <sub>PHL</sub>	C <sub>L</sub> = 15pF	5	13	-	-	-	ns
Maximum Clock Frequency	f <sub>MAX</sub>	C <sub>L</sub> = 15pF	5	50	-	-	-	MHz
Power Dissipation Capacitance (Notes 2, 3)	C <sub>PD</sub>	C <sub>L</sub> = 15pF		45	-	-	-	pF

#### NOTES:

2. C<sub>PD</sub> is used to determine the dynamic power consumption, per flip-flop.
3. P<sub>D</sub> = V<sub>CC</sub><sup>2</sup> f<sub>i</sub> + ∑ (C<sub>L</sub> V<sub>CC</sub><sup>2</sup> + f<sub>O</sub>) where f<sub>i</sub> = Input Frequency, f<sub>O</sub> = Output Frequency, C<sub>L</sub> = Output Load Capacitance, V<sub>CC</sub> = Supply Voltage.

Test Circuit and Waveforms

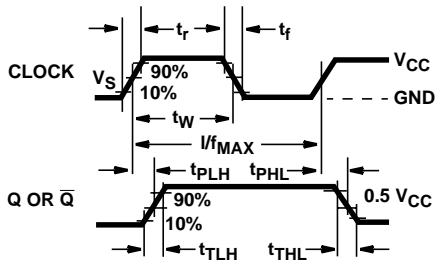


FIGURE 1. CLOCK PREREQUISITE AND PROPAGATION DELAYS AND OUTPUT TRANSITION TIMES

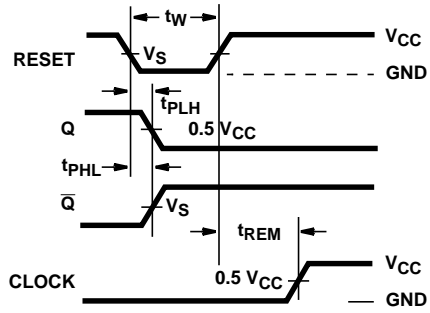


FIGURE 2. MASTER RESET PREREQUISITE AND PROPAGATION DELAYS

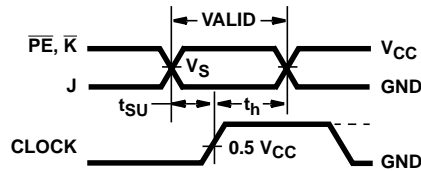


FIGURE 3. J,  $\bar{K}$ , OR PARALLEL ENABLE PREREQUISITE TIMES

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
CD74HC195E	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD74HC195EE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD74HC195M	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195M96	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195M96E4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195M96G4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195ME4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195MG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195NSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195NSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195NSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195PW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195PWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195PWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195PWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195PWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195PWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195PWT	ACTIVE	TSSOP	PW	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195PWTE4	ACTIVE	TSSOP	PW	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC195PWTG4	ACTIVE	TSSOP	PW	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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**TAPE AND REEL INFORMATION**
**REEL DIMENSIONS**

**TAPE DIMENSIONS**


A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

**TAPE AND REEL INFORMATION**

\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD74HC195M96	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
CD74HC195NSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
CD74HC195PWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
CD74HC195PWT	TSSOP	PW	16	250	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD74HC195M96	SOIC	D	16	2500	333.2	345.9	28.6
CD74HC195NSR	SO	NS	16	2000	367.0	367.0	38.0
CD74HC195PWR	TSSOP	PW	16	2000	367.0	367.0	35.0
CD74HC195PWT	TSSOP	PW	16	250	367.0	367.0	35.0

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G16)

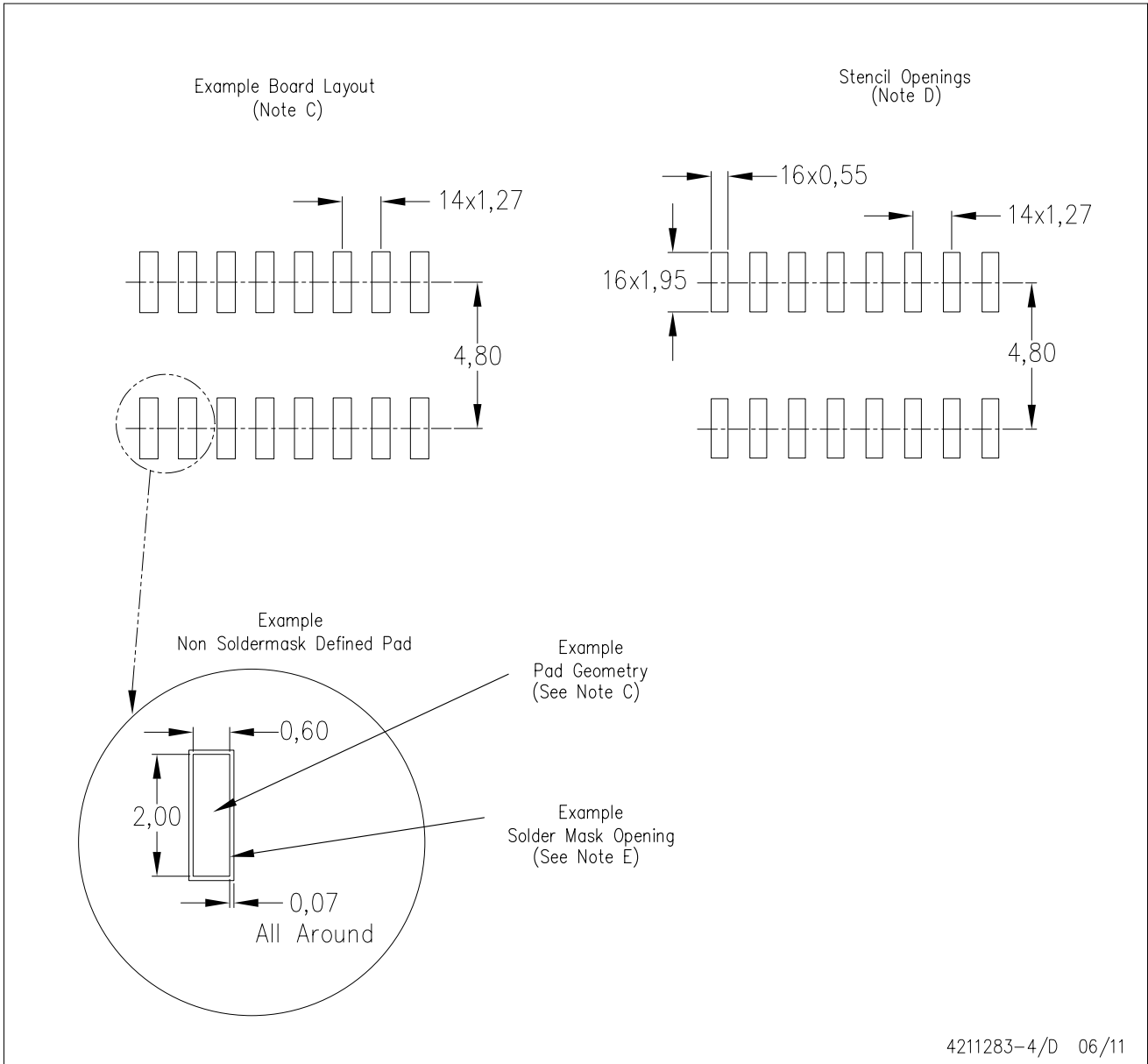
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

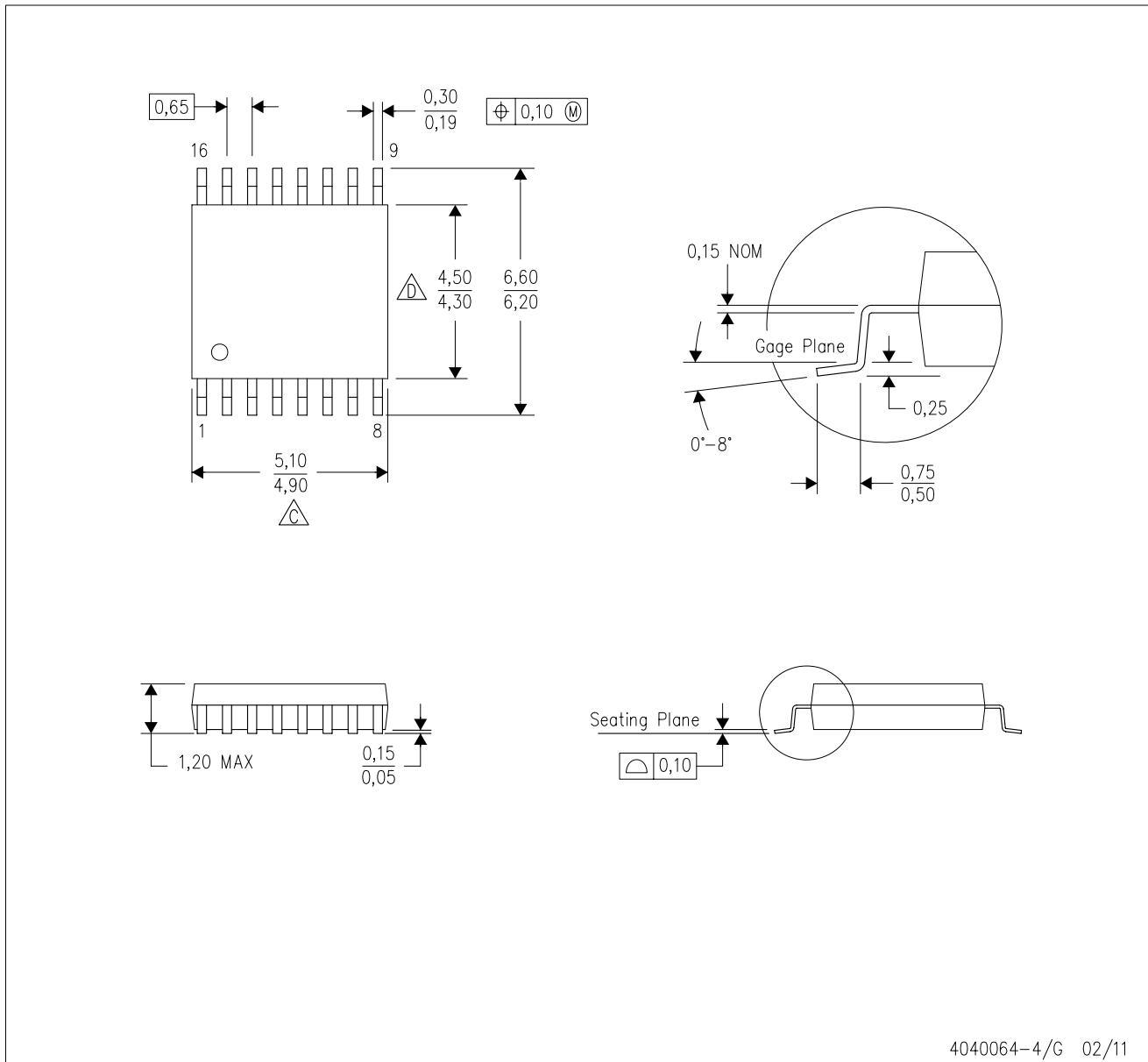
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE

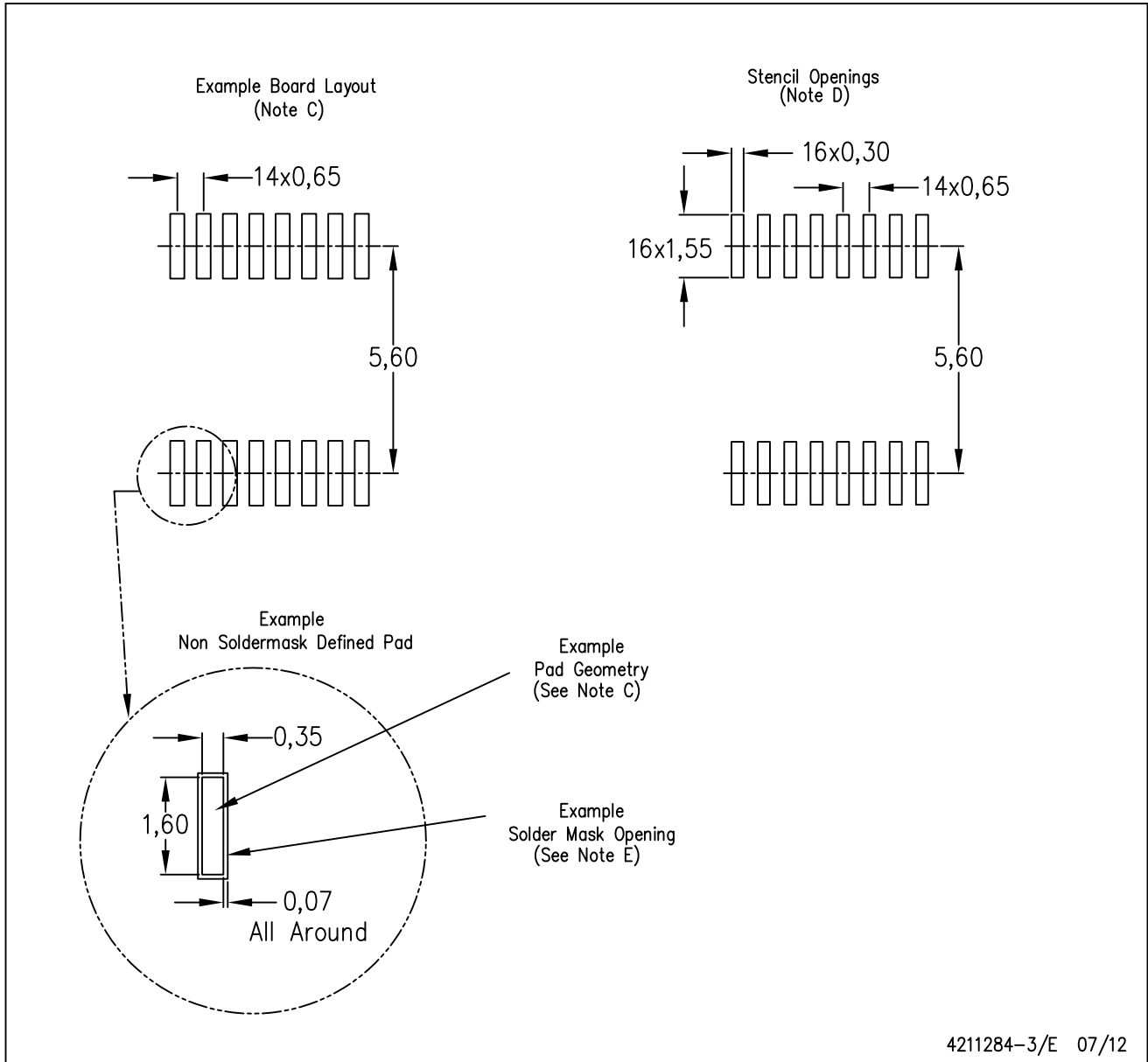


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- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  -  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  -  Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

## IMPORTANT NOTICE

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